Subgroup-Specific Effects of Questionnaire Wording on Population-Based Estimates of Mammography Prevalence

Paul Z. Siegel, MD, MPH, Judith R. Qualters, PhD, MPH, Paul D. Mowery, PhD, Stefano Campostrini, PhD, Craig Leutzinger, and David V. McQueen, ScD

ABSTRACT

Objectives. This study investigated whether an apparent downturn in prevalence rates of mammography use reported in the 1992 Behavioral Risk Factor Surveillance System (BRFSS) questionnaire resulted from a change in questionnaire wording.

Methods. In a pretest–posttest design (1990–1991 vs 1992), piecewise linear regression analyses were based on monthly prevalence estimates of mammography use among female BRFSS respondents 40 years or older.

Results. Self-reported mammography use was lower by 3.5 percentage points (95% confidence interval [CI]= 1.5, 5.5) overall—and lower by 13.6 percentage points (95% CI=2.6, 24.6) among Black women with less than a high school education—when predicted from 1992 data than when predicted from 1990–1991 data.

Conclusions. A change in questionnaire wording in the BRFSS caused demographic-specific effects in population-based estimates of mammography use. (*Am J Public Health.* 2001;91: 817–820)

The Behavioral Risk Factor Surveillance System (BRFSS)—the principal data source for measuring mammography usage and progress toward objectives at the state level[1–8]—has been used since 1987 to collect state-based data on breast cancer screening. In comparison with 1991, reported mammogram usage in 1992 decreased in 11 of 47 (23%) participating states (Table 1),[9] despite the nationwide upward trend toward increased mammography use.[10–13] We report the results of additional analyses designed to evaluate whether wording changes in the BRFSS questionnaire may have accounted for the apparent downturn.

Methods

Data Source

The BRFSS is a cross-sectional telephone survey of US noninstitutionalized civilian adults 18 years or older. Our study included female respondents 40 years or older from the 45 states that participated in the BRFSS from 1990 through 1992. Participating states conduct a predetermined number of interviews each year, divided into 12 equal monthly samples. Each month's sample is an independent probability sample.

The median state response rate (ratio of completed interviews to sum of completed interviews and refusals) ranged from a low of 82.9% (1992) to a high of 84.1% (1991).[9] State sample sizes for women 40 years or older ranged from 277 to 1144; aggregated samples ranged from 26 175 (1990) to 29 468 (1992), and the monthly range was 2032 to 2581. Further details on sampling method,[14] purpose,[15] and method of analysis[16,17] of the BRFSS have been published previously.

BRFSS Mammography Questions

In each study year, women were asked, "Have you ever had a mammogram?" The introductory wording to this question, however, was different in 1990–1991 ("These next questions are about mammograms, which are x-ray tests of the breast to look for cancer") and 1992 ("I would like to ask you a few questions about a medical examination called a mammogram. A mammogram is an x-ray of the breast and involves pressing the breast between two plastic plates"). The changes introduced in 1992 were intended to provide clarification for respondents who might otherwise confuse a mammogram with a chest x-ray and to make the wording more consistent with that of the National Health Interview Survey.

Data Analysis

The percentage of women who had ever had a mammogram was estimated for each month.[18] Data from each state were weighted according to the age-, race-, and sex-specific population counts from the most current census (or intercensal estimate) as well as to the respondent's probability of selection.

To test for the possible effect of questionnaire changes, we conducted weighted piecewise linear regression analyses[19,20] for 2 time periods: January 1990 through December 1991 and January 1992 through December 1992. The analysis was weighted by the inverse of the variance of each monthly prevalence estimate. A *t* test was used to compare the slopes of each time period.

Indicator variables were incorporated into the model to examine discontinuity in

Paul Z. Siegel and Craig Leutzinger are with the Division of Adult and Community Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, Ga. Judith R. Qualters is with the Division of Environmental Hazards and Health Effects, National Center for Environmental Health, Centers for Disease Control and Prevention. Paul D. Mowery is with the Research Triangle Institute, Research Triangle Park, NC. Stefano Campostrini is with the Department of Statistical Sciences, University of Padova, Padova, Italy. David V. McQueen is with the Office of the Director, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention.

Requests for reprints should be sent to Paul Z. Siegel, MD, MPH, Mail Stop K30, Centers for Disease Control and Prevention, Atlanta, GA 30341-3724 (e-mail: pzs1@cdc.gov).

This brief was accepted August 10, 2000.

TABLE 1—Percentages of Women 40 Years or Older Who Reported Having Ever Had a Mammogram, by State: Behavioral Risk Factor Surveillance System, 1991 and 1992

State	1991, %	1992, %	Change
Alabama	69.9	74.3	+4.4
Alaska	74.3	75.2	+0.9
Arizona	70.2	75.2	+5.0
California	81.2	79.9	−1.3
Colorado	74.3	80.3	+6.0
Connecticut	76.9	81.9	+5.0
Delaware	73.8	78.0	+4.2
District of Columbia	84.1	81.1	−3.0
Florida	75.8	73.0	−2.8
Georgia	72.9	71.4	−1.5
Hawaii	74.3	75.9	+1.6
Idaho	68.5	72.0	+3.5
Illinois	69.9	73.8	+3.9
Indiana	68.5	71.9	+3.4
Iowa	65.9	73.5	+7.6
Kentucky	64.5	67.0	+2.5
Louisiana	61.6	65.4	+3.8
Maine	77.8	79.7	+1.9
Maryland	77.8	80.2	+2.4
Massachusetts	79.1	78.9	-0.2
Michigan	75.4	82.3	+6.9
Minnesota	78.9	80.6	+1.7
Mississippi	60.5	57.4	−3.1
Missouri	68.8	70.9	+2.1
Montana	72.1	74.3	+2.2
Nebraska	62.1	65.8	+3.7
New Hampshire	79.5	78.7	−0.8
New Jersey	69.1	69.2	+0.1
New Mexico	64.1	76.4	+12.3
New York	69.6	75.6	+6.0
North Carolina	69.6	73.2	+3.6
North Dakota	74.5	73.5	−1.0
Ohio	68.6	71.6	+3.0
Oklahoma	65.7	71.4	+5.7
Oregon	81.7	81.9	+0.2
Pennsylvania	72.7	72.8	+0.1
Rhode Island	78.9	79.7	+0.8
South Carolina	70.9	71.1	+0.2
South Dakota	69.2	74.0	+4.8
Tennessee	67.6	68.1	+0.5
Texas	74.3	69.9	−4.4
Utah	71.0	78.1	+7.1
Vermont	76.2	77.4	+1.2
Virginia	75.9	73.5	−2.4
Washington	82.8	80.9	−1.9
West Virginia	64.9	67.2	+2.3
Wisconsin	75.7	76.7	+1.0

the regression function at the point at which new wording was initiated (the cutpoint). Parameter estimates for indicator variables reflect the changes or "jumps" in the vertical distances between the 2 line segments (time periods) at the January 1992 cutpoint. We used *t* tests to evaluate whether these jumps were significantly different from zero. A statistically significant jump would be consistent with a questionnaire wording effect; the magnitude of the observed jump would be equal to the estimated magnitude of the questionnaire effect.

Separate regression analyses were performed for the entire study population as well as demographic subgroups (Table 2). We analyzed race–education groupings to look for potential interaction effects.

Results

The annual percentage of women 40 years or older who reported having ever had a mammogram increased 5 percentage points from 1990 to 1991 but only 1.5 percentage points from 1991 to 1992 (Table 2). From 1990 to 1991, the percentage of women who reported having undergone a mammogram increased in every demographic subgroup. In contrast, between 1991 and 1992, small decreases occurred among women with less than a high school education and among Black women regardless of educational attainment. In 1990 and 1991, the percentage of women undergoing screening was lowest among White women with less than a high school education. In 1992, however, the percentage was lowest among Black women with less than a high school education.

The rate of increase in the prevalence of mammography use was similar for the 2 time intervals (there was no statistically significant difference between slopes; see Figure 1). The estimated prevalence of mammography use at the January 1992 cutpoint was 3.5 percentage points lower when predicted from the 1992 data (72.8%) than when predicted from the 1990–1991 data (76.3%) (Figure 1 and Table 2). A downward shift occurred for every demographic subgroup (Table 2) and was greatest for Black women who had less than a high school education (a decrease of 13.6 percentage points).

Discussion

The change in the 1992 BRFSS questionnaire reduced the measured population prevalence of mammography use by 3.5 percentage points. The magnitude of the effect varied according to race and level of education and was largest among Black women who had less than a high school education. Researchers who conduct trend analyses should be aware of concerns regarding the comparability of 1992 BRFSS mammography data with BRFSS mammography data from other years as well as its comparability with data from other systems.

Our study design did not enable us to determine the wording that produced more accurate results. The downward direction of the shift is consistent with the hypothesis that the 1992 "plastic plates" wording reduced the number of false-positive responses among respondents who perhaps had undergone a chest x-ray that they reported as a mammogram on the basis of the 1990–1991 wording. The downturn in 1992, however, is also consistent with an increase in the number of false-negative responses, perhaps as a result of removal of the phrase "to look for cancer."

Under ideal circumstances, respondents' self-reports could be validated against a gold standard such as hospital or clinic records. Because the BRFSS is conducted anonymously, this type of validation is not possible. Several studies have measured the validity of self-reported mammography use against medical records, but none of these studies attempted to compare the validity of different survey questions.[21–25]

A thorough assessment of the effect of changes in questionnaire wording on the validity of BRFSS data would require conducting a split-sample survey of mammography usage with follow-up validation of medical records. Additional potentially useful approaches include focus groups[26] and cognitive testing.[27] □

TABLE 2—Percentages of Women 40 Years or Older Who Reported Ever Having Had a Mammogram, by Survey Year and Selected Demographic Characteristics: Behavioral Risk Factor Surveillance System, 1990–1992

Characteristic	Year of Survey, %			Difference, January 1992[a] (95% Confidence Interval)
	1990	1991	1992	
Age group, y				
40–49	68.5	73.7	75.2	−3.7 (−7.2, −0.2)
50–64	72.4	76.9	78.3	−1.8 (−4.9, 1.3)
≥65	64.7	70.2	71.8	−4.2 (−7.3, −1.1)
Race/ethnicity				
White	69.0	73.9	75.8	−2.7 (−4.9, −0.5)
Black	65.9	71.7	69.8	−10.5 (−17.4, −3.6)
Other	62.2	67.3	67.3	−5.0 (−17.5, 7.5)
Education				
Less than high school	57.7	62.3	61.9	−7.2 (−12.1, −2.3)
High school or more	71.9	76.7	78.4	−2.2 (−4.4, 0.4)
Race × education				
White, less than high school	57.7	62.0	62.3	−6.2 (−11.5, −0.9)
White, high school or more	72.1	77.0	79.0	−1.6 (−4.0, 0.8)
Black, less than high school	60.9	65.0	60.9	−13.6 (−24.6, −2.6)
Black, high school or more	69.4	75.8	74.5	−10.1 (−18.3, −1.9)
Employment status				
Employed	71.4	75.9	77.4	−3.2 (−6.1, −0.3)
Unemployed	66.4	72.6	72.8	−5.6 (−10.1, −1.1)
Retired	66.1	71.2	73.0	−2.9 (−8.6, 2.8)
Income				
≤14 999	57.7	64.5	64.4	−4.6 (−8.1, −1.1)
15 000–34 999	69.7	73.8	75.7	−5.1 (−8.6, −1.6)
≥35 000	80.2	83.6	85.6	−1.3 (−4.2, 1.6)
Total	68.5	73.5	75.0	−3.5 (−5.5, −1.5)

[a]January 1992 prevalence predicted from 1992 data minus the prevalence predicted from 1990–1991 data.

Contributors

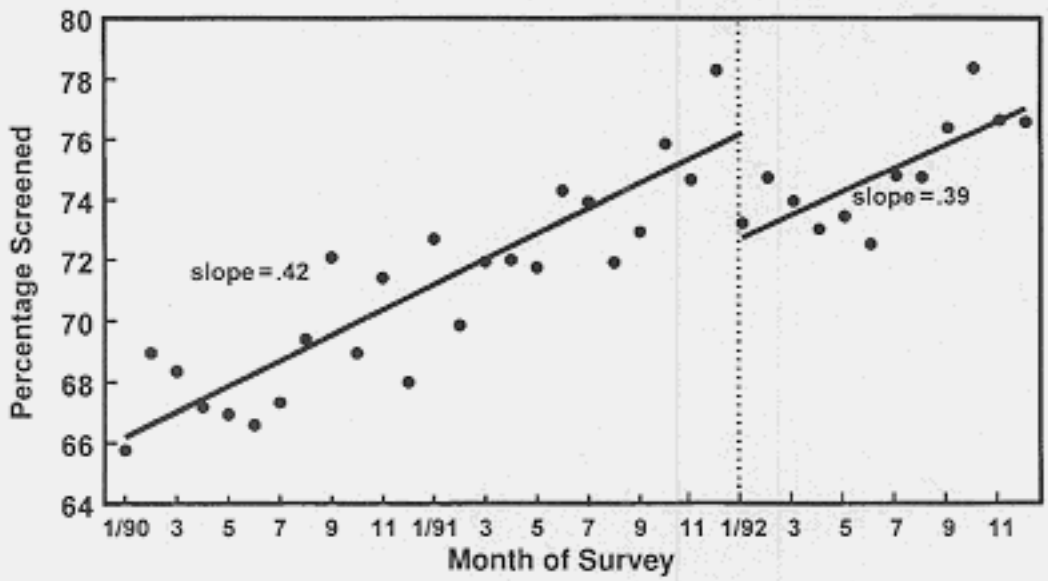
All of the authors contributed substantially to the conception and design of the study or to the analysis and interpretation of the data as well as to drafting or revision of content. The authors will provide any relevant data upon request.

Acknowledgments

We acknowledge the contributions of the state BRFSS coordinators as well as the outstanding graphics support provided by Barbara Dougherty.

References

1. Centers for Disease Control and Prevention. Mammography and clinical breast examinations among women aged 50 years and older—Behavioral Risk Factor Surveillance System, 1992. *MMWR Morb Mortal Wkly Rep*. 1992;42:737–741.
2. Centers for Disease Control and Prevention. Use of cervical and breast cancer screening among women with and without functional limitations—United States, 1994–1995. *MMWR Morb Mortal Wkly Rep*. 1998;47:853–856.
3. Centers for Disease Control and Prevention. Self-reported use of mammography and insurance status among women aged 40 years—United States. *MMWR Morb Mortal Wkly Rep*. 1998;47:825–830.
4. Siegel PZ, Frazier EL, Mariolis P, Brackbill RM, Smith C. Behavioral risk factor surveillance, 1991: monitoring progress toward the nation's



Note. The difference at cutpoint was −3.5 ($P < .05$).

FIGURE 1—Percentage of women 40 years or older who reported ever having had a mammogram, monthly point estimates, and piecewise regression, by month of survey: Behavioral Risk Factor Surveillance System, 1990–1992.

year 2000 health objectives. *MMWR CDC Surveill Summ.* 1993;42(SS-4):1–22.
5. *Cancer Facts and Figures, 1997.* Atlanta, Ga: American Cancer Society; 1997.
6. Centers for Disease Control and Prevention. Self-reported use of mammography among women aged 40 years—United States, 1989 and 1995. *MMWR Morb Mortal Wkly Rep.* 1997;46: 937–941.
7. Centers for Disease Control and Prevention. State- and sex-specific prevalence of selected characteristics—Behavioral Risk Factor Surveillance System, 1992 and 1993. *MMWR CDC Surveill Summ.* 1996;45(SS-6).
8. Centers for Disease Control and Prevention. State- and sex-specific prevalence of selected characteristics—Behavioral Risk Factor Surveillance System, 1994 and 1995. *MMWR CDC Surveill Summ.* 1997;46(SS–3).
9. *1993 BRFSS Quality Control Report.* Atlanta, Ga: Centers for Disease Control and Prevention; 1994.
10. National Center for Health Statistics. Breast cancer risk factors and screening: United States, 1987. *Vital Health Stat 10.* 1990;No. 172.
11. National Center for Health Statistics. Health promotion and disease prevention: United States, 1990. *Vital Health Stat 10.* 1993;No. 185.
12. Martin LM, Wingo PA, Calle EE, et al. Comparison of mammography and Pap test use from the 1987 and 1992 National Health Interview Surveys: are we closing the gaps? *Am J Prev Med.* 1996;12:82–90.
13. Breen N, Kessler L. Changes in the use of screening mammography: evidence from the 1987 and 1990 National Health Interview Surveys. *Am J Public Health.* 1994;84:62–67.
14. Waksberg JS. Methods for random digit dialing. *J Am Stat Assoc.* 1978;73:40–46.
15. Remington PL, Smith MY, Williamson DF, et al. Design, characteristics, and usefulness of state-based behavioral risk factor surveillance: 1981–1987. *Public Health Rep.* 1988;103: 366–375.
16. Gentry EM, Kalsbeek WD, Hogelin GC, et al. The behavioral risk factor surveys, Part II: design, methods, and estimates from combined state data. *Am J Prev Med.* 1985;1:9–14.
17. Behavioral risk factor data. In: *Using Chronic Disease Data: A Handbook for Public Health Practitioners.* Atlanta, Ga: Centers for Disease Control; 1992:1–17.
18. *SAS/STAT Users Guide.* vol. 2. Cary, NC: SAS Institute Inc; 1996.
19. Neter J, Wasserman W. *Applied Linear Statistical Models.* Homewood, Ill: Richard D Irwin Inc; 1974.
20. Draper N, Smith H. *Applied Regression Analysis.* 2nd ed. New York, NY: John Wiley & Sons Inc; 1981.
21. King ES, Rimer BK, Trock B, et al. How valid are mammography self-reports? *Am J Epidemiol.* 1990;80:1386–1388.
22. Etzi S, Lane DS, Grimson R. The use of mammography vans by low-income women: the accuracy of self-reports. *Am J Public Health.* 1994;84:107–109.
23. Degnan D, Harris R, Ranney J, et al. Measuring the use of mammography: two methods compared. *Am J Public Health.* 1992;82:1386–1388.
24. Johnson CS, Archer J, Campos-Outcalt D. Accuracy of Pap smear and mammogram self-reports in a southwestern Native American tribe. *Am J Prev Med.* 1995;11:360–363.
25. Whitman S, Lacey L, Ansell D, et al. Do chart reviews and interviews provide the same information about breast and cervical cancer screening? *Int J Epidemiol.* 1993;22:393–397.
26. Danigelis NL, Roberson NL, Worden JK, et al. Breast screening by African-American women: insights from a household survey and focus groups. *Am J Prev Med.* 1995;11:311–317.
27. Beatty P. *NCI Questionnaire Development and Testing: DES, Mammography Decisional Balance, and Clinical Breast Exams.* Hyattsville, Md: National Center for Health Statistics; 1995. Working paper series 16.